The Sensitivity of River Catchments to Dissolved Organic Carbon Release During Rain Events - A Study of Eight Catchments in Southern Patagonia

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Research Article

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Abstract

Understanding the role of catchment properties is crucial for anticipating soil-derived dissolved organic carbon (DOC) export to aquatic systems, especially under changing climatic conditions. We present natural variations in DOC concentrations and fluxes in eight catchments differing in size (3 – 300 km 2), morphology (very steep to flat), and landscape type (Patagonian steppe, forest and peatland) along a steep precipitation gradient in remote pristine southern Patagonia, Chile. Discharge, precipitation and water chemical parameters were used to differentiate the mechanisms controlling DOC release in different catchment types. The results show large differences between catchments in terms of DOC concentrations (2 - 47 mg L -1) and fluxes (1 to 44 tons km -2 yr -1) but also in response to changes in precipitation. Small steep and forested catchments are the most reactive in terms of DOC export; specifically, changes in discharge produce fast, high and exponential increases in DOC release. DOC leaching by surface run-off through the organic soil layer is the main source of DOC during high precipitation events, and steep catchments became short-term hotspots for DOC export. In the flat catchments of the Patagonian steppe, the generally lower precipitation rates favour temporal accumulation of DOC in soils, and seasonal high discharge events produce one-off increases in DOC fluxes. Although peatlands constitute a large and continuous source of DOC export, the influence of discharge variation on DOC fluxes in peatland-dominated catchments appears to be low, despite the large carbon pools. Thus, in DOC catchments with similar precipitation regimes, morphology is the dominant factor determining ecosystem responses, where the steepest catchments show the highest sensitivity to rain events in terms of DOC export. Morphology and hydrological buffer capacity rather than the size of the carbon pools or precipitation intensity determine the export of DOC from catchments during strong rain events.

Full Text

Due to technical limitations, full-text HTML conversion of this manuscript could not be completed. However, the latest manuscript can be downloaded and accessed as a PDF.

Figures

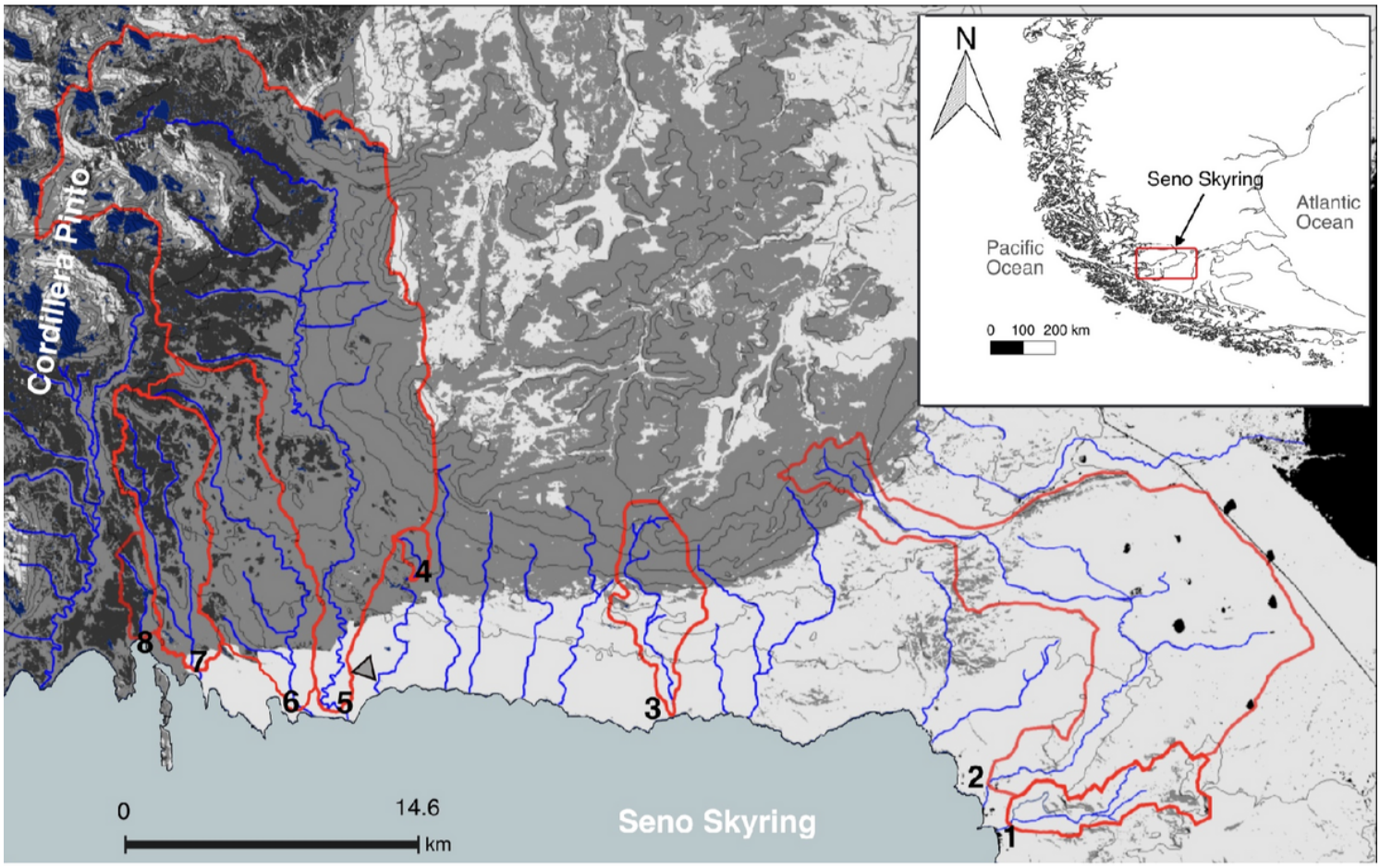

Figure 1

Map of the research area, showing the distribution of vegetation and localization of river (blue) and related catchments (red) along the Seno Skyring area (53° S); Triangle= location of the weather-station AWS “Skyring”. Sampling sites from east to west, Chorrillo Laguna (1), Río Verde (2), Virgen de Montserrat (3), Río Bosquecillo (4), Río Perez (5), Río Leon (6), Rio Nutria (7), and Rio Turba (7). Colours indicate the distribution of the dominating vegetation with black= vegetation free, dark grey= mires, grey= forest, light grey= (sub-)alpine emerge vegetation and (sub-)alpine grassland, (anthropogenic grassland), white = Fuego-Patagonian steppe. Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.

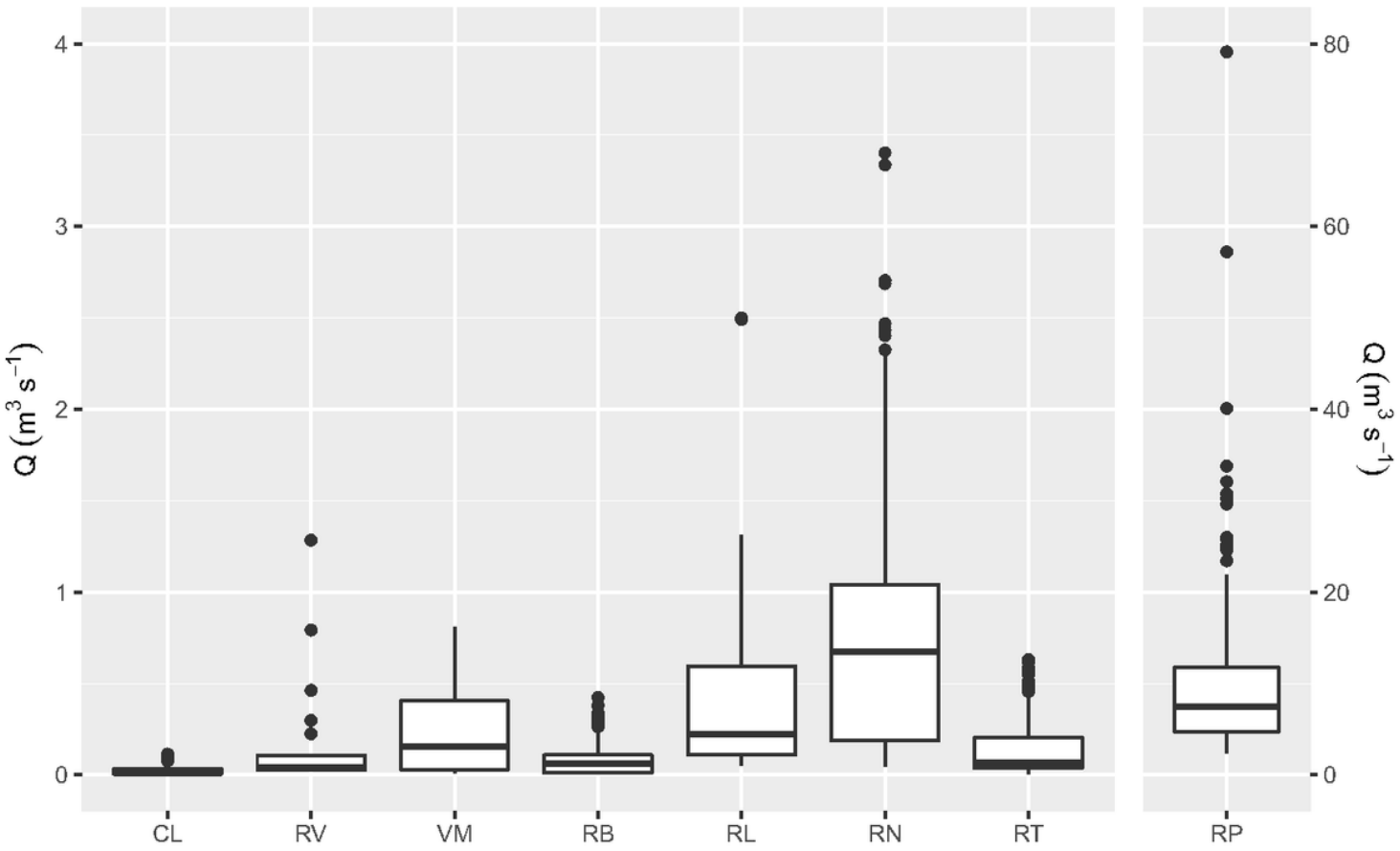

Figure 2

Annual discharge of the eight study rivers. Box plots for CL, RB, RN, RT and RP are base on continuous and punctual measurements while RV, VM and RL only in punctual measurements. More in formation in the text. In box plots: horizontal lines in the rectangle indicates the median, top and bottom of the rectangle indicate the third and first quartile respectively; whiskers show maximum and minimum; and individual points are outliers.

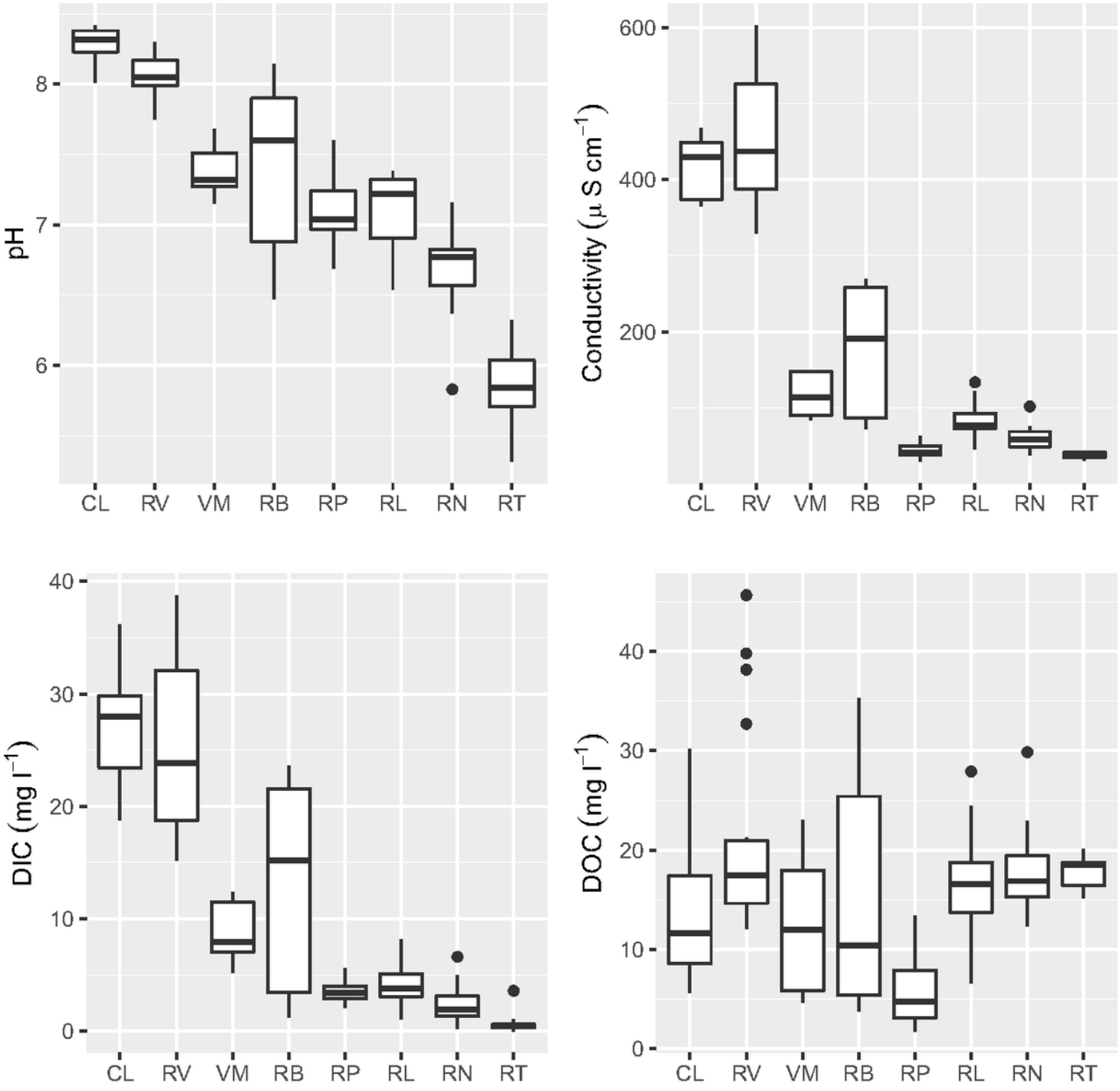

Figure 3

Annual data for pH, conductivity, DIC and DOC concentrations of the eight study rivers. In box plots: horizontal lines in the rectangle indicates the median, top and bottom of the rectangle indicate the third and first quartile respectively; whiskers show maximum and minimum; and individual points are outliers.

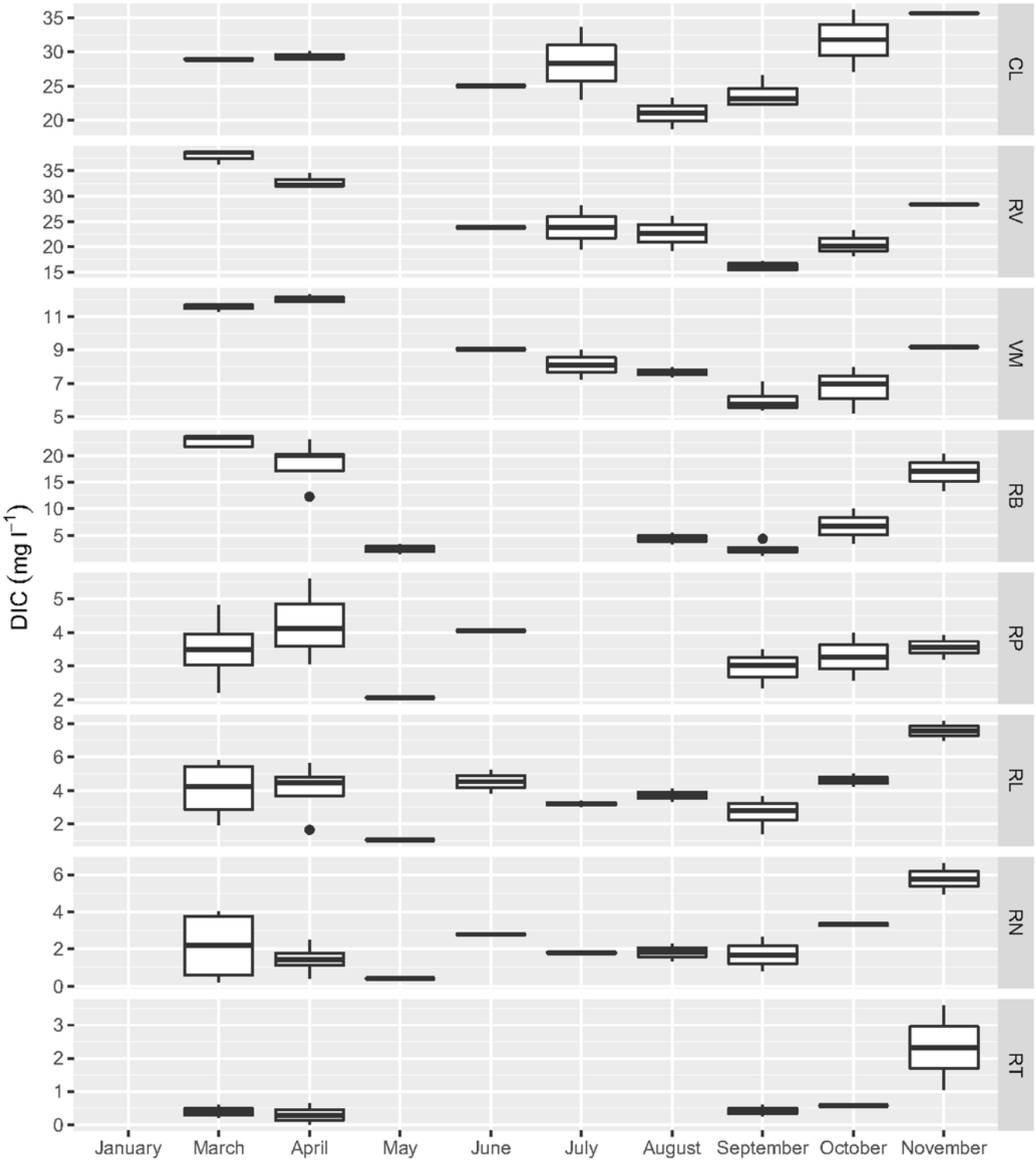

Figure 4

Monthly data of DIC concentration in the eight study rivers. Only months for which data is available are represented. Notice different y-axis for every river.

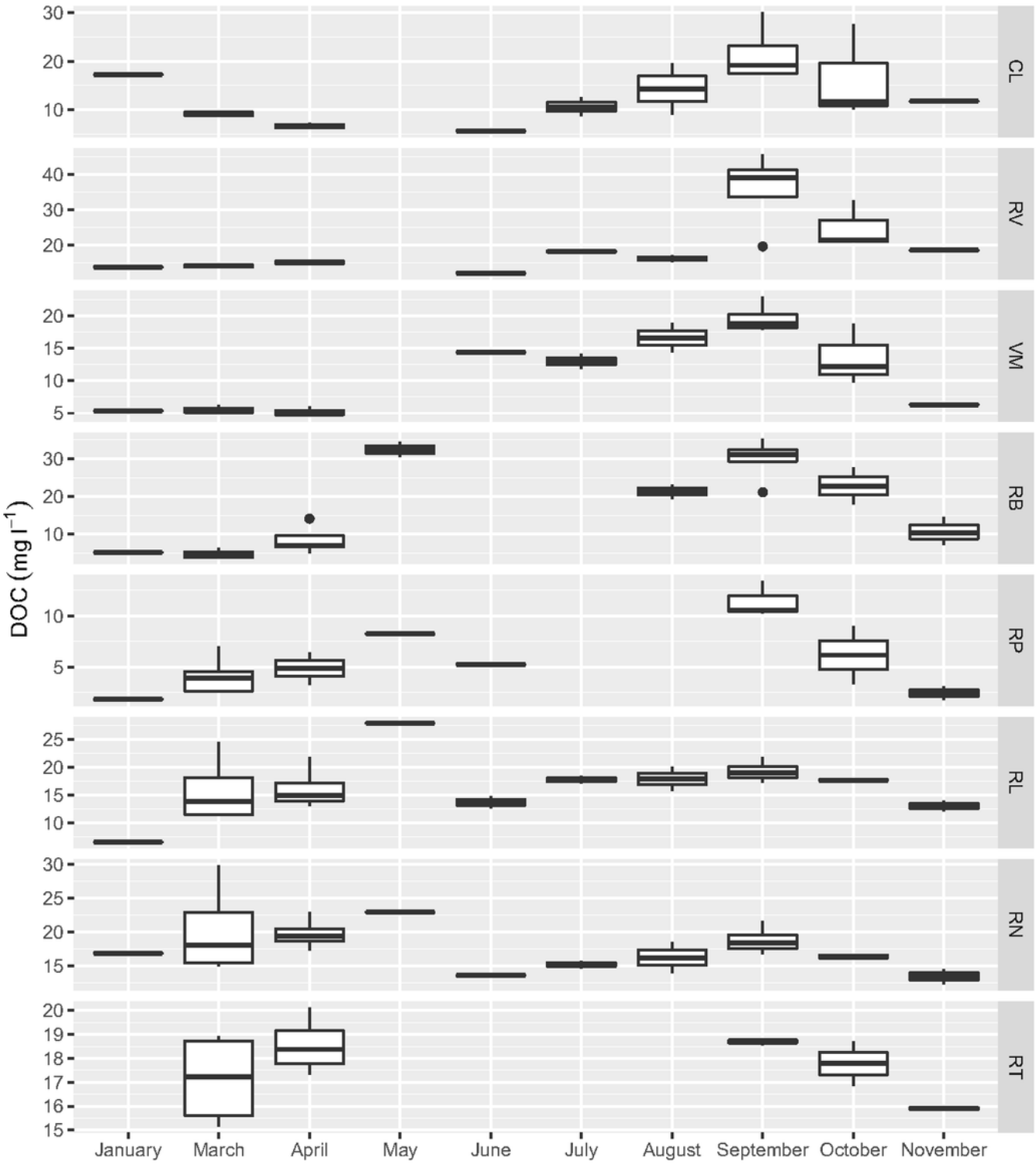

Figure 5

Monthly data of DOC concentrations in the eight study rivers. Only months for which data is available are represented. Notice different y-axis for every river.

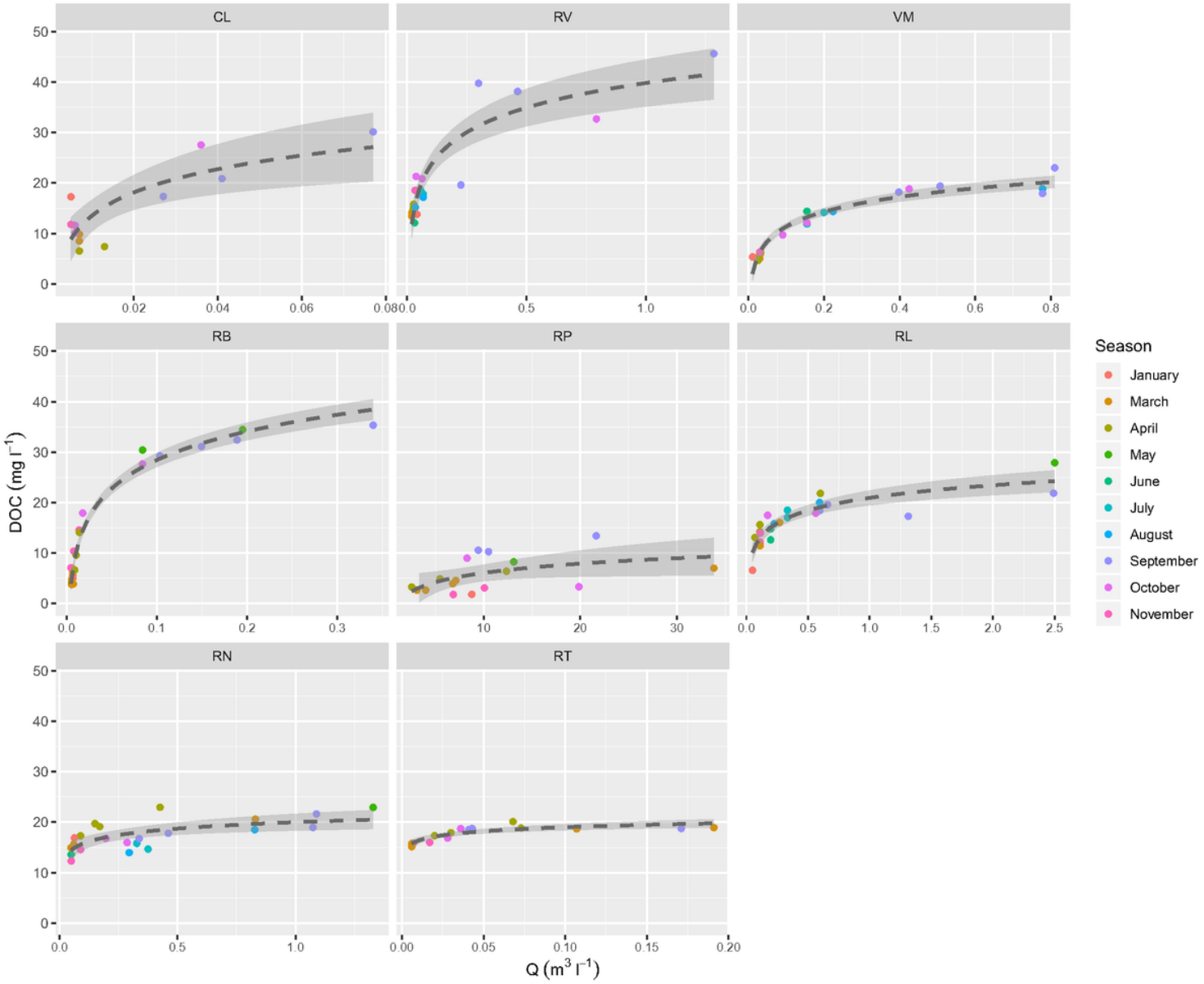

Figure 6

DOC concentrations against discharge (Q) in the eight study rivers. Discontinuous lines indicate the logarithmic regression and grey shadows show the confidence interval (0.95). Color of the points indicate sampling month.

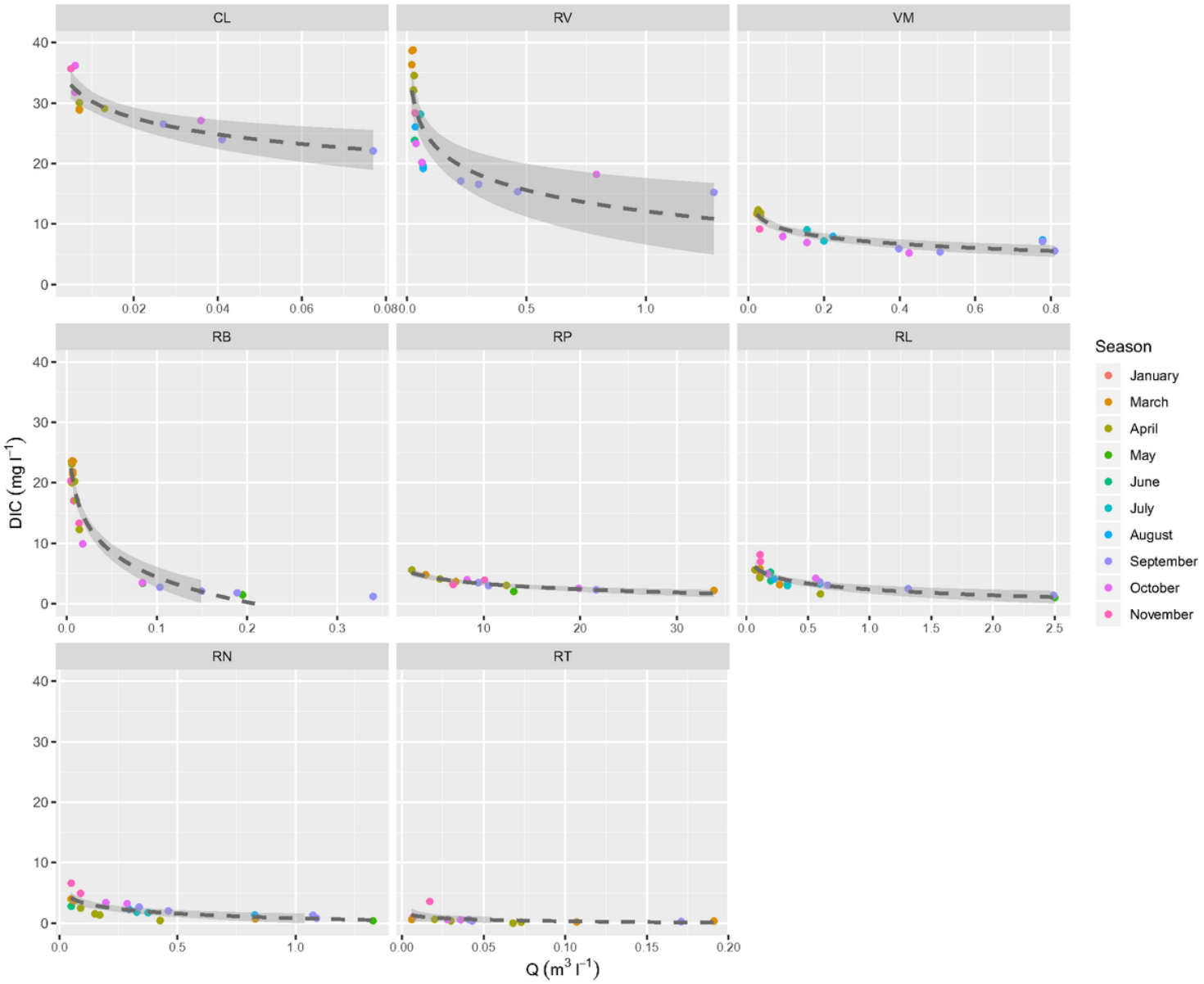

Figure 7

DIC concentrations against discharge (Q) in the eight study rivers. Discontinuous lines indicate the logarithmic regression and grey shadows show the confidence interval (0.95). Color of the points indicate sampling month.

Supplementary Files

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- CatchmentsensitivityDOCPatagoniasupplementary.pdf